DATA ANALYSIS COMPLEMENTING PROXIMATE MODELING OF WEEKDAY/WEEKEND OZONE DIFFERENCES IN SOUTHERN CALIFORNIA

SPONSORED BY:
COORDINATING RESEARCH COUNCIL
NATIONAL RENEWABLE ENERGY LABORATORY

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OVERVIEW

• OBJECTIVES
  > DETERMINE IF WEEKEND/WEEKDAY OZONE DIFFERENCES ARE RELATED TO VOC OR NOx LIMITATION AS DETERMINED FROM ANALYSIS OF AMBIENT DATA
  > COMPLEMENT CONCURRENT MODELING

• KEY ELEMENTS OF APPROACH
  > AMBIENT CONCENTRATIONS OF PRECURSORS
  > AMBIENT CONCENTRATIONS OF OZONE
    - FOCUS ON HIGH OZONE DAYS
  > EXTENT OF REACTION
  > COMPARE WITH MODELING
DATABASE

• FIVE AIR BASINS
  > SOUTH COAST
  > MOJAVE
  > SALTON SEA
  > SOUTH CENTRAL COAST
  > SAN DIEGO

• FOUR TO EIGHT YEARS DATA
  > 1991-97 OZONE
  > 1994-97 OZONE AND VOC/NOx LIMITATION
  > UPDATE TO 1998 OR 1999

• OZONE SEASON
  > MARCH THROUGH OCTOBER
  > AT LEAST 75 PERCENT OF ONE OZONE SEASON
  > AT LEAST TWO YEARS DATA FOR SOME ANALYSES

• SPECIES
  > 102 OZONE SITES
  > 76 NOx
  > 47 CO
  > 3 NMOC, FORMALDEHYDE
  > 8 BENZENE, TOLUENE
KEY FINDINGS

• BOTH NOx AND NMOC CONCENTRATIONS LOWER ON WEEKENDS THAN ON WEEKDAYS. EVIDENCE FOR LOWER NOx IS STRONGER THAN EVIDENCE FOR LOWER NMOC.

• PRECURSOR CONCENTRATIONS LOWER ON SUNDAYS THAN ON SATURDAYS.

• OZONE MAY BE LOWER OR HIGHER ON WEEKENDS THAN ON WEEKDAYS. NEARBY SITES HAVE SIMILAR PATTERNS.

• LIMITING OZONE PRECURSOR MAY BE VOC OR NOx. NEARBY SITES ARE SIMILAR.

• SPATIAL PATTERN OF DIFFERENCES BETWEEN WEEKEND AND WEEKDAY OZONE CORRELATES WITH LIMITING OZONE PRECURSOR.
Percentage Decreases in Mean Weekend Precursor Concentrations Compared With Mean Weekday Concentrations (Averaged Over All Sites, 1991-97)

The NMOC data are very limited (samples collected every third day, usually July-Oct; no data before 1994). Most NMOC differences are not statistically significant.
Statistical Significance of Comparisons of Saturday Morning Concentrations With Weekday Concentrations
(Tested by Site for All Sites, 1991-97)

NOx and CO based on Wilcoxon Signed Rank Test
> paired nonparametric test appropriate for daily data with serial correlation

NMOC, benzene, toluene, and formaldehyde based on Two-Sample t-test
> unpaired test appropriate for every third day sampling schedule
Statistical Significance of Comparisons of Sunday Morning Concentrations With Weekday Concentrations
(Tested by Site for All Sites, 1991-97)

NOx and CO based on Wilcoxon Signed Rank Test
> paired nonparametric test appropriate for daily data with serial correlation

NMOC, benzene, toluene, and formaldehyde based on Two-Sample t-test
> unpaired test appropriate for every third day sampling schedule
DELINEATING VOC vs NOx LIMITATION

- USE SMOG PRODUCTION (SP) ALGORITHM
  > MEASUREMENTS OF $O_3$, NO, NO$_x$ or NO$_y$
  > EXTENT OF REACTION
    ⇨ INDICATES WHICH PRECURSOR LIMITS INSTANTANEOUS RATE OF OZONE FORMATION AT SPECIFIC TIME AND PLACE

- CRITERIA
  > VOC-LIMITED WHEN EXTENT $< 0.6$
  > TRANSITIONAL WHEN $0.6 \leq$ EXTENT $< 0.9$
  > NO$_x$-LIMITED WHEN EXTENT $\geq 0.9$
Bounding the Extent of Reaction Using Routine NOx Data
Mean Weekday Peak-Hour Extent of Reaction
(Top 3 Ozone Values Each Day of the Week Each Year, 1994 - 1997)
Mean Sunday Peak Ozone Minus Mean Weekday Peak Ozone versus Mean Extent of Reaction at the Time of the Peak Ozone High-Ozone Days 1994 - 1997 (Top 3 Ozone Values for Each Day of the Week Each Year)
Mean Saturday Peak Ozone Minus Mean Weekday Peak Ozone
versus
Mean Extent of Reaction at the Time of the Peak Ozone
High-Ozone Days 1994 - 1997
(Top 3 Ozone Values for Each Day of the Week Each Year)
CONCLUSION

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WORK TO DO

• UPDATE THROUGH 1998

• STATISTICAL SIGNIFICANCE OF OZONE DIFFERENCES